



FIELD EPIDEMIOLOGY



Contingency Operations Course



Why Bother?

- ✦ **Primary public health reason to investigate an outbreak is to control the outbreak and prevent further disease**
 - Other reasons: research, training, public relations, politics, legalities**

The 10 Steps of Outbreak Investigation

- ① Prepare for field work**
- ② Establish existence of outbreak**
- ③ Take steps to verify the diagnosis**
- ④ Define and identify cases**
- ⑤ Perform descriptive epidemiology**

The 10 Steps of Outbreak Investigation

- ⑥ Develop hypothesis**
- ⑦ Evaluate hypothesis**
- ⑧ Reconsider/refine hypothesis**
- ⑨ Implement prevention & control**
- ⑩ Communicate findings**

1. Prepare for Field Work

✦ Investigation

- Scientific knowledge--have it or get it!**
- Supplies, equipment**
- Assemble your team**

▢ Administration

- Review OIs, local directives**

▢ Consultation

- Know your role, especially if off-base**

2. Establish the Existence of An Outbreak

- ✦ **Determine if disease incidence is higher than background level**
- ▢ **Only way to know background is through disease surveillance**

Incidence

Incidence Rate:

$$I = \frac{\text{\# of new cases or events}}{\text{number at risk in population}} \text{During a specified time period}$$

- * It must be possible for each person in denominator to contribute to the numerator (be “at risk” for the event)
- * The counts in the numerator and denominator should cover the same time period

Incidence

- Use a constant such as 1,000 or 10,000 to put the rate in terms that are meaningful to commanders

- Example:
$$\frac{\text{\# cases of AGE}}{\text{total \# AD assigned}} \times 1,000$$

During 1st week of May

Incidence Rate

Example:

$$\frac{23 \text{ cases of AGE} \times 1,000}{3,200 \text{ AD assigned}} \quad \text{During 1st week of May}$$

Answer: 7 cases AGE per
1,000 AD for the 1st week of
May

Reasons

Observed > Expected

- ✦ **Change in reporting procedures**
- ▮ **Change in case definition**
- ▮ **Increased awareness or interest**
- ▮ **Improved diagnostics**
- ▮ **New clinician or ICO**
- ▮ **Change in Population**
- ▮ **True increase**

3. Take Steps to Verify

✦ **Ensure proper diagnosis**

- ▮ **Rule out lab error (if available)**
- ▮ **Visit and interview patients**
 - **Understanding of clinical features**
 - **Mental image of outbreak**
- ▮ **Set up frequency distributions**

FREQUENCY DISTRIBUTION

Symptom Frequency

<i>Nausea</i>	<i>78%</i>
<i>Cramps</i>	<i>68%</i>
<i>Headache</i>	<i>50%</i>
<i>Vomiting</i>	<i>48%</i>
<i>Diarrhea</i>	<i>32%</i>
<i>Fever</i>	<i>14%</i>

4. Define and Identify Cases

- ✦ **Outbreak Case Definition:**
 - **Clinical information (signs and symptoms)**
 - **Person**
 - **Place**
 - **Time**

Case Definition Sources

- ✦ Routine reporting: Use CDC or JTF definition
- ▢ Unknown etiology: Make up your own case definition
 - make sure everyone uses the same case definition

Case Definition for Hep A

Report as...

Confirmed Case

Probable Case
ALT

Suspected Case
following:
pain, Fever,
Malaise

Definitions

Anti-HAV IgM +

Jaundice or elevated

Any two of the
Abdominal

Nausea, Anorexia,

Line Listing

Case ID	Report Date	Onset Date	Dx	Clinical Symptoms					Lab		Age	Sex	Unit
				N	V	A	F	J	HAV-IgM	Other			
1	10/12	10/9	Hep A	+	+	+	+	+	+	ALT Elev	35	M	CSG
2	10/12	10/10	Hep A	+	+	+	+	-	NA	ALT Elev	37	M	CSG
3	10/12	10/10	Hep A	-	+	+	+	+	+	HBsAg-	30	F	CSG
4	10/13	10/11	Hep A	-	-	+	+	+	+	NA	17	M	MED

5. Perform Descriptive Epidemiology

✦ **Person**

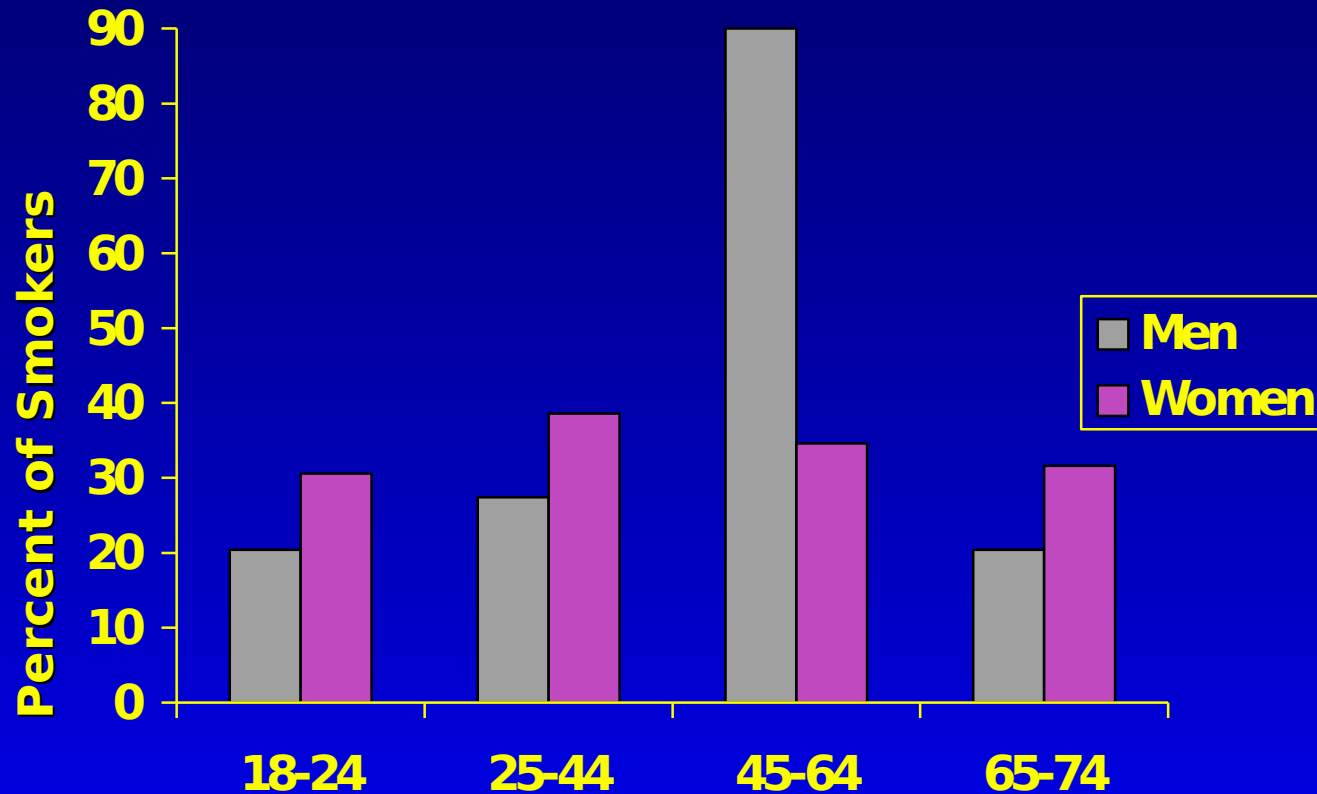
▮ **Place**

▮ **Time**

Descriptive Epi: *Person*

- ✦ **Host: age, race, gender**
- ▮ **Exposures: occupation, leisure activities, medications, drugs**
- ▮ **Disease-specific risk factors: sexual exposure, IV drug use**

Person



Town X

Descriptive Epi: *Place*

✦ **Spot map: simple and effective**

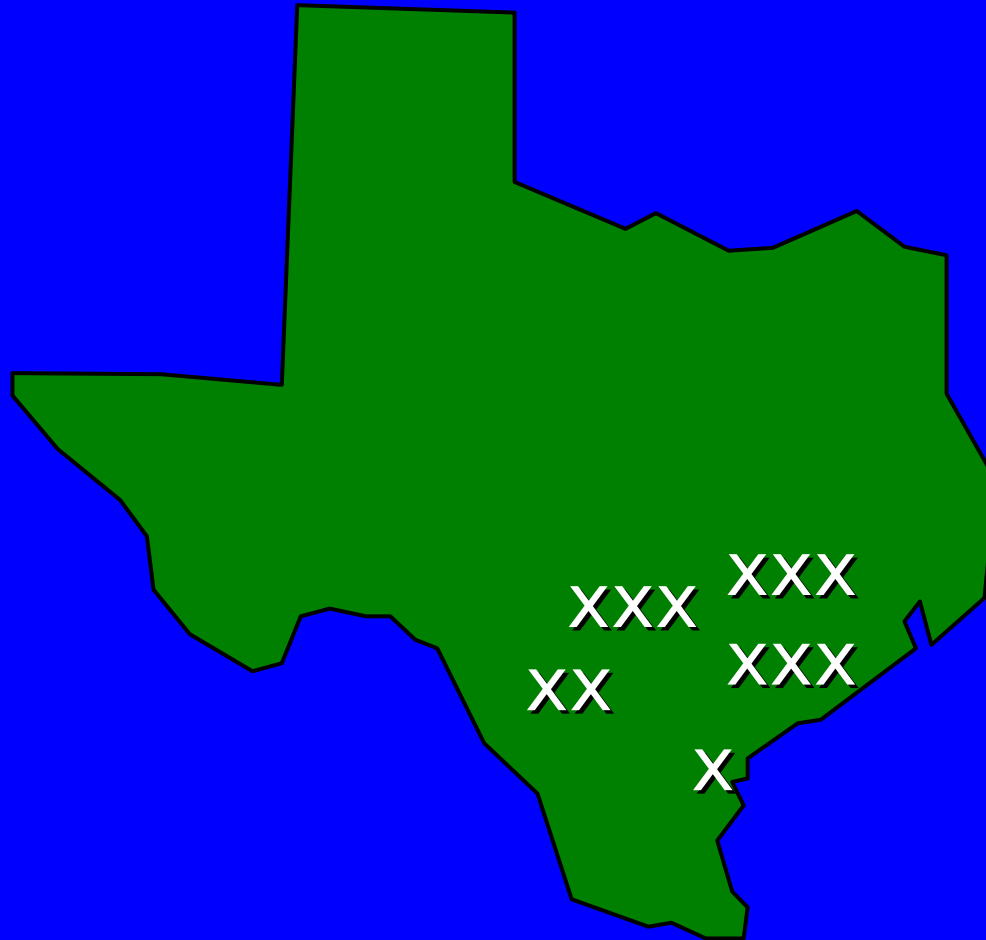
▢ **Identifies:**

- **Geographic extent of outbreak**
- **Clustering or patterns**

▢ **Applications**

- **Facilities: hospitals, dining hall
seating arrangements, surgical suites**

Place

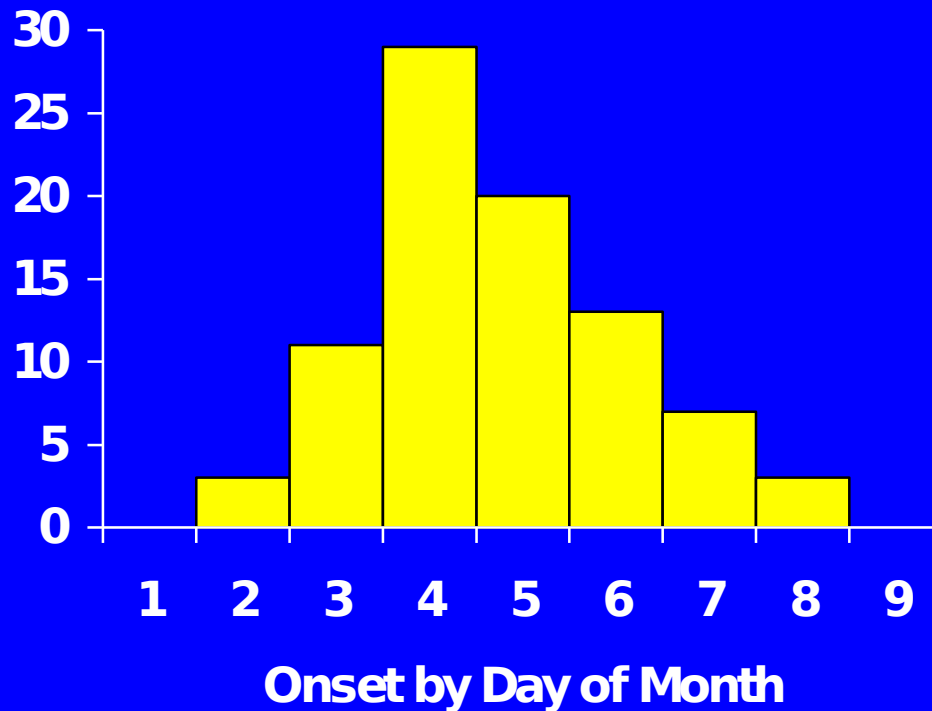


Descriptive Epi: *Time*

- ✦ **Draw epidemic curve**
 - **No. of cases by time of onset or dx**
 - **Tells Us:**
 - ♦ **“Where are we now?”**
 - ♦ **“What’s the forecast?”**
 - ♦ **Probable time of exposure (maybe)**
 - ♦ **Epidemic pattern**

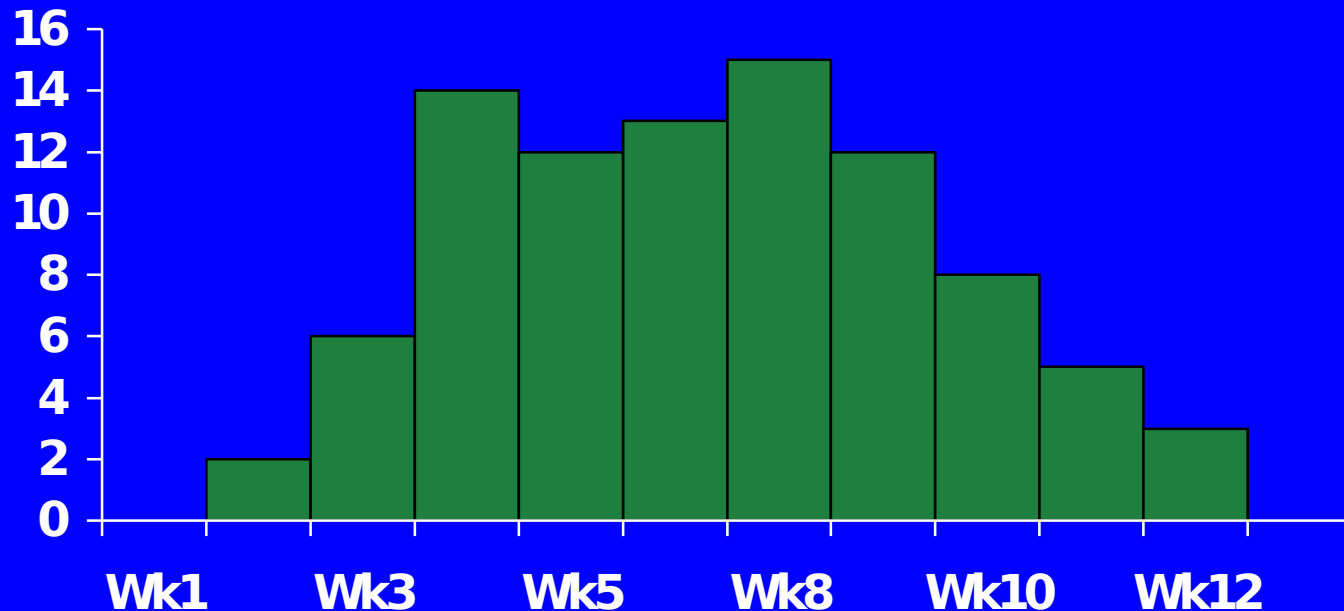
Epidemic Curve: Interpretation

Epidemic Curve:
Typical Point Source Outbreak



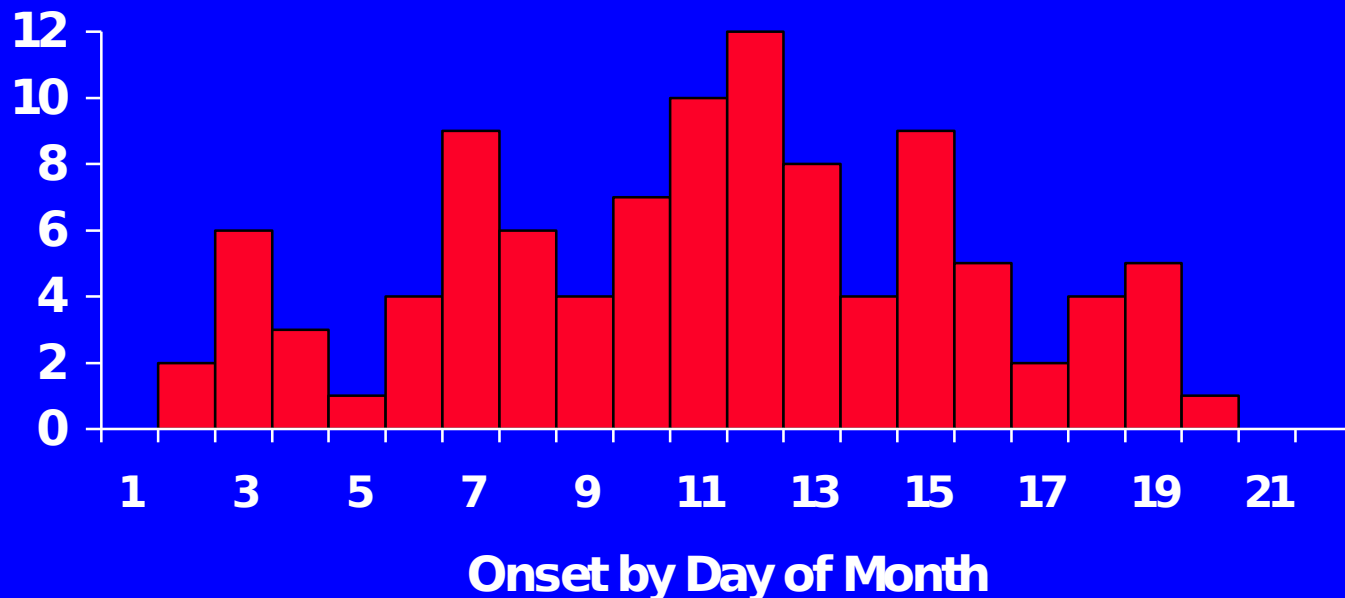
Epidemic Curve: Interpretation

Epidemic Curve:
Typical Continuous Common Source Outbreak



Epidemic Curve: Interpretation

Epidemic Curve:
Typical **Propagated** Outbreak



6. Develop Hypothesis

- ✦ ***Round up usual suspects!***
- ✦ **Source of agent**
 - ▢ **Mode of transmission**
 - ▢ **Usual reservoirs**
 - ▢ **Known risk factors**
 - ▢ **Exposures that caused disease**
 - ▢ **Look at person, place and time for clues**

Develop Hypothesis

- ✦ **Requires familiarity with disease**
- ▢ **Hypothesis should be testable**
- ▢ **Still clueless?**
 - **Talk with cases again**
 - **Visit work sites or billeting area**
 - **Don't forget outliers**

7. Evaluate Hypothesis

- ✦ **Evaluate hypothesis - 2 ways**
 - **Descriptive epidemiology (Person, Place, and Time)**
 - **Analytic epidemiology (statistics) - use comparison group**
- ▢ **Compare hypothesis with established facts**

Evaluate Hypothesis via Descriptive Epidemiology

- ✦ **Clinical, laboratory, environmental, and/or epidemiologic evidence overwhelming**
- ▢ **Example:**
 - All cases had bloody diarrhea; *E.coli* isolated from stools
 - All had same ready-to-eat food; no other common exposures
 - Salad prep person at dining facility had same strain of *E. coli* 2 weeks earlier

Evaluate Hypothesis via Analytical Epidemiology

Hallmark of Analytic Epi is the Comparison Group

- ✦ Perform Cohort or Case Control Study
- ▢ Construct a 2 x 2 table
- ▢ Compare ill to not ill (or exposed to unexposed)

	III a	Not III b
Exposed	c	d
Not Exposed		

Cohort Study

- ✦ **Use Cohort study when:**
 - **Population at risk is known (you have a denominator)**
- ▮ **Interview “ill” and “not ill”**
- ▮ **Calculate attack rates - “ate” vs “didn’t eat”**
- ▮ **Put on food-specific attack rate table**

Cohort Study

Attack rate by consumption of vanilla ice cream, Oswego NY, April 1940

		ILL	WELL	Total	AR (%)
Ate vanilla ice cream?	YES	43	11	54	79.6
	NO	3	18	21	14.3

$\frac{79.6 - 14.3}{1} = 5.6$

Attack rate in exposed = $43/54 = 79.6\%$

Attack rate in unexposed = $3/21 = 14.3\%$

%

Relative Risk (RR)

- ▮ RR is a measure of association
(shows how strong of an association there is between the exposure and the disease)
- ▮ RR calculation gives you one number
- ▮ Reflects “risk of disease”

Relative Risk

- ✦ In previous example, the RR of 5.6 simply means that those who ate vanilla ice cream were 5.6 times more likely to get sick than those who did not eat vanilla ice cream.

. . . And that's all it says.

Relative Risk

- ✦ Remember...you can only calculate an attack rate when you have a denominator
- ▮ You need denominators (attack rates) to calculate RR
- ▮ Therefore, you must know total population exposed and not exposed (the denominators) or you can't use RR

Case Control Study

- ✦ **Used when population at risk not well defined (no denominator)**
- ▢ **Start with a group of cases (the ill)**
- ▢ **Select comparison group (controls)**
 - ◆ **The “not ill” group**
 - ◆ **Representative of population**
 - ◆ **Examples: random sample, friends, neighbors, family, other patients**

Case Control Study

- ✦ Since there is no denominator, you cannot calculate risk directly (by dividing attack rate of exposed by attack rate of unexposed).
- ▮ Must estimate the risk by using the Odds Ratio (OR) as your measure of association

Odds Ratio (OR)

- Looking at ratio of exposed (8) to not exposed (3) among cases and comparing it to ratio of exp. (5) to not exp. (15) among controls
- Exposed to tick bites?

NO

CASE		CONTROL	
YES	8	YES	5
NO	3	NO	15

Odds Ratio

Formula: $\frac{a/c}{b/d}$

Change it algebraically to:
 $\frac{ad}{bc}$

Odds Ratio = The “X” or the “Cross Product Ratio”

Odds Ratio

$$\frac{ad}{bc} = \frac{8 \times 15}{5 \times 3} = 8.0$$

$$\frac{8 \times 15}{5 \times 3}$$

	<i>CASE</i>	<i>CONTROL</i>
<i>YES</i>	8	5
<i>NO</i>	3	15

Odds Ratio

- ▮ Odds Ratio of 8.0
- ▮ Reflects your odds of exposure
- ▮ Stated:
If you are sick, you were 8 times more likely to have been bitten by ticks during field exercise.

8. Refine Hypothesis

- ✦ **As necessary, reconsider/
refine hypothesis and
execute additional studies**
 - additional epidemiologic
studies**
 - other types of studies --
laboratory, environmental**

9. Implement Prevention & Control Measures

✦ Agent, source, or reservoir

- Destroy contaminated food**
- Disinfecting contaminated water**
- Destroy vector breeding sites**

▢ Transmission, host susceptibility

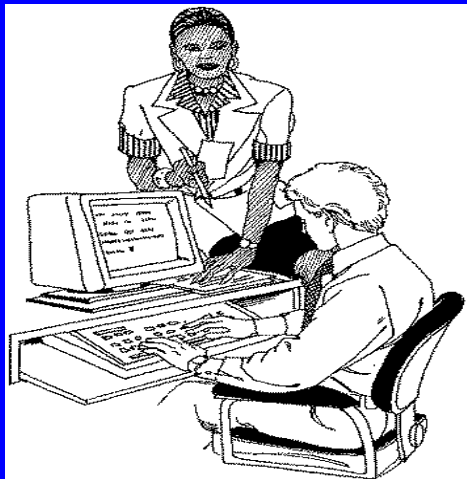
- Personal protective countermeasures**
- Immunizations**
- Malaria chemo prophylaxis**

10. Communicate the Findings

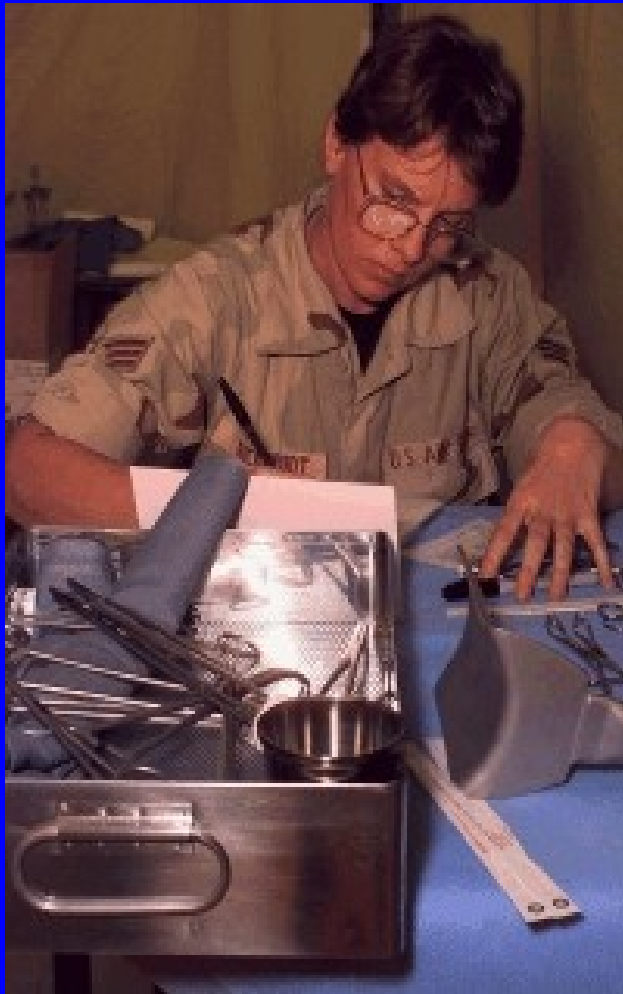
- ✦ **Follow administrative guidance**
- ▢ **Include descriptive epidemiology**
- ▢ **Be objective**
- ▢ **Serves as a reference and historical document**

Communicate Findings

- ▣ **Dissemination**
 - One-way process
- ▣ **Communication**
 - Sender receives feedback



Field Epi Review



- ✦ What is the main reason that we investigate potential outbreaks?

Summary of the 10 Steps of Outbreak Investigation

- ① Prepare for field work**
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Summary of 10 Steps

- ⑥ **Develop hypothesis**
- ⑦ **Evaluate hypothesis**
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- ⑩ **Communicate findings**

The Epi Approach...

- ✦ **Identify a problem**
- ▮ **Investigate and collect data**
- ▮ **Describe data in terms of person, place and time**
- ▮ **Formulate a hypothesis**
- ▮ **Test your hypothesis**

Bottom Line...

- ✦ **Collect good descriptive data**
 - ▮ **Be observant**
 - ▮ **Keep commander informed**
 - ▮ **Be sure to collect data on both the “ill” and the “not ill”**
 - ▮ **Ask for help**
 - ▮ **Always work hard at preventing disease!**

